

Claims 1-8 (Cancelled).

9. (Currently Amended) A fracture prediction device for use with a spot welded portion, comprising:

an input arrangement configured to input at least one of a tensile strength (TS) of a material strength, a plate thickness t, a nugget diameter d of a spot welding, a plate width w of a particular joint, or a rotation angle θ of the joint plates in a tension testing procedure which is at least one of a cross tension testing procedure or a shear tension test procedure at a spot welded joint;

a first calculation arrangement configured to determine a fracture limit load (Fcts) as a fracture strength parameter of the spot welded portion in at least one of a cross tension using a formula (a) or a shear tension and a fracture limit load (Ftss) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), based on a stress concentration factor α and at least one of the inputted tensile strength TS of the material strength, the plate thickness t, the nugget diameter d of the spot welding, the plate width w of the joint, or the rotation angle θ of the particular joint in the tension testing procedure, wherein the stress concentration factor α is at least one of (i) defined by a formula of (tensile strength TS)/(mean tensile stress σ_0) or (ii) calculated using a stress concentration factor calculation formula, and wherein

$$F_{cts} = 2 TS W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = TS W t / \alpha \quad (b);$$

a parameter storage arrangement configured to store the fracture strength parameter by each steel type; and

a second calculation arrangement configured to analyze a fracture of the spot welded portion by providing the fracture strength parameter stored in the parameter storage arrangement into a fracture prediction formula in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture prediction formula is based on a shear force and a vertical force with respect to the spot welded portion.

10. (Currently Amended) A fracture prediction device provided for a spot welded portion, comprising:

an input arrangement configured to input at least one of a tensile strength (TS) of a material strength, a plate thickness t, a nugget diameter d of a spot welding, a plate width w of a particular joint, or a rotation angle θ of the joint plates in a tension testing procedure which is at least one of a cross tension testing procedure or a shear tension testing procedure at a spot welded joint;

a first calculation arrangement configured to determine a fracture limit load (Fcts) as a fracture strength parameter of the spot welded portion in at least one of a cross tension, using a formula (a), and a fracture limit load (Ftss) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), or a shear tension based on a fracture strength curve of the spot welded portion obtained from a stress concentration factor α and at least one of the inputted tensile strength TS of the material strength, the plate thickness t, the nugget diameter d of the spot welding, the plate width w of the joint, or the rotation angle θ of the particular joint in the tension testing procedure, wherein the stress concentration factor α is at least one of (i) defined

by a formula of (TS) / (mean tensile stress σ_0) or (ii) calculated using a stress concentration factor calculation formula, and wherein

$$F_{cts} = 2 TS W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = TS W t / \alpha \quad (b);$$

a parameter storage arrangement configured to store the fracture strength parameter by each steel type; and

a second calculation arrangement configured to analyze a fracture of the spot welded portion by providing the fracture strength parameter stored in the parameter storage arrangement into a fracture limit line in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture limit line is created as a curve based on a shear force and a vertical force with respect to the spot welded portion.

11. (Currently Amended) A fracture prediction method provided for a spot welded portion, comprising:

inputting at least one of a tensile strength (TS) of a material strength, a plate thickness t, a nugget diameter d of a spot welding, a plate width w of a particular joint, or a rotation angle θ of the particular joint in a tension test which is at least one of a cross tension testing procedure or a shear tension testing procedure at a spot welded joint;

determining a fracture limit load (F_{cts}) as a fracture strength parameter of the spot welded portion in at least one of a cross tension or a shear tension using a formula (a), and a fracture limit load (F_{tss}) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), based on a stress concentration factor α

and at least one of the inputted tensile strength TS of the material strength, the plate thickness t, the nugget diameter d of the spot welding, the plate width w of the joint, or the rotation angle θ of the joint in the tension testing procedure, wherein the stress concentration factor α is at least one of (i) defined by a formula of (~~tensile strength TS~~)/(mean tensile stress σ_0) or (ii) calculated using a stress concentration factor calculation formula, and wherein

$$F_{cts} = 2 \text{ TS } W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = \text{TS } W t / \alpha \quad (b);$$

storing the fracture strength parameter by each steel type in a parameter storage arrangement; and

analyzing a fracture of the spot welded portion by providing the fracture strength parameter stored in the parameter storage arrangement into a fracture prediction formula in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture prediction formula is based on a shear force and a vertical force with respect to the spot welded portion.

12. (Currently Amended) A fracture prediction method for a spot welded portion, comprising:

inputting at least one of a tensile strength (TS) a material strength, a plate thickness t, a nugget diameter d of a spot welding, a plate width w of a particular joint, or a rotation angle θ of the particular joint in a tension test which is at least one of a

cross tension testing procedure or a shear tension testing procedure at a spot welded joint;

determining a fracture limit load (Fcts) as a fracture strength parameter of the spot welded portion in a cross tension using a formula (a) and a fracture limit load (Ftss) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), based on a stress concentration factor α and at least one of a fracture tension-strength curve of a spot welded portion provided from at least one of the inputted tensile strength TS of the material strength, the plate thickness t , the nugget diameter d of the spot welding, the plate width w of the joint, or the rotation angle θ of the joint in the tension testing procedure, wherein the stress concentration factor α is at least one of (i) defined by a formula of (TS) / (mean tensile stress σ_0) or (ii) calculated using a stress concentration factor calculation formula, and wherein

$$F_{cts} = 2 TS W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = TS W t / \alpha \quad (b);$$

storing the fracture strength parameter by each steel type in a parameter storage arrangement; and

analyzing a fracture of the spot welded portion by providing the fracture strength parameter stored in the parameter storage arrangement into a fracture limit line in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture limit line is created as a curve based on a shear force and a vertical force with respect to the spot welded portion.

13. (Currently Amended) A computer storage arrangement provided for a fracture prediction of a spot welded portion to design a circuit, comprising:

a first set of instructions which, when executed by a processing arrangement, configure the processing arrangement to determine a fracture limit load (Fcts) as a fracture strength parameter of the spot welded portion in at least one of a cross tension using a formula (a), and a fracture limit load (Ftss) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), or a shear tension based on a stress concentration factor α and at least one of a tensile strength (TS) of a material strength, a plate thickness t , a nugget diameter d of a spot welding, a plate width w of a particular joint, and a rotation angle θ of the particular joint in a tension testing procedure based on at least one of a cross tension testing procedure or a shear tension testing procedure at a spot welded joint, wherein the stress concentration factor α is at least one of (i) defined by a formula of (tensile strength TS)/(mean tensile stress σ_0) or (ii) calculated using a stress concentration factor calculation formula, and wherein

$$F_{cts} = 2 TS W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = TS W t / \alpha \quad (b);$$

a second set of instructions which, when executed by the processing arrangement, configure the processing arrangement to store the fracture strength parameter by each steel type in a parameter storage arrangement; and

a third set of instructions which, when executed by the processing arrangement, configure the processing arrangement to analyze a fracture of the spot welded portion by providing the fracture strength parameter stored in the parameter storage

arrangement into a fracture prediction formula in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture prediction formula is based on a shear force and a vertical force with respect to the spot welded portion.

14. (Currently Amended) A computer storage arrangement provided for a fracture prediction of a spot welded portion to design a circuit, comprising:

a first set of instructions which, when executed by a processing arrangement, configure the processing arrangement to determine a fracture limit load (Fcts) as a fracture strength parameter of the spot welded portion in at least one of a cross tension using a formula (a) and a fracture limit load (Ftss) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), based on a stress concentration factor α and ~~or a shear tension a fracture strength curve of the spot welded portion provided from at least one of a tensile strength (TS) of a material strength, a plate thickness t , a nugget diameter d of a spot welding, a plate width w of a particular joint, and a rotation angle θ of the particular joint in a tension testing procedure based on at least one of a cross tension testing procedure or a shear tension testing procedure at a spot welded joint, wherein the stress concentration factor α is at least one of (i) defined by a formula of (TS) / (mean tensile stress σ_0) or (ii) calculated using a stress concentration factor calculation formula, and wherein~~

$$F_{cts} = 2 TS W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = TS W t / \alpha \quad (b);$$

a second set of instructions which, when executed by the processing arrangement, configure the processing arrangement to store the fracture strength parameter by each steel type in a parameter storage arrangement; and

a third set of instructions which, when executed by the processing arrangement, configure the processing arrangement to analyze a fracture of the spot welded portion by providing the fracture strength parameter stored in the parameter storage arrangement into a fracture limit line in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture limit line is created as a curve based on a shear force and a vertical force with respect to the spot welded portion.

15. (Currently Amended) A non-transitory computer-accessible medium including a computer program thereon which, when executed by a processing arrangement, configures the processing arrangement to perform the procedures comprising:

determining a fracture limit load (F_{cts}) as a fracture strength parameter of a spot welded portion in at least one of a cross tension using a formula (a), and a fracture limit load (F_{tss}) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), ~~or a shear tension~~ based on a stress concentration factor α and at least one of a tensile strength (TS) of a material strength, a plate thickness t , a nugget diameter d of a spot welding, a plate width w of a joint, and a rotation angle θ of the joint in a tension testing procedure obtained based on at least one of a cross tension testing procedure or a shear tension testing procedure at a spot welded joint, wherein the stress concentration factor α is at least one of (i) defined by a formula of (tensile

~~strength-TS)/(mean tensile stress σ_0)~~ or (ii) calculated using a stress concentration factor calculation formula, and wherein

$$F_{cts} = 2 TS W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = TS W t / \alpha \quad (b);$$

storing the fracture strength parameter by each steel type in a parameter storage arrangement; and

analyzing a fracture of the spot welded portion by providing the fracture strength parameter stored in the parameter storage arrangement into a fracture prediction formula in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture prediction formula is based on a shear force and a vertical force with respect to the spot welded portion.

16. (Previously Presented) A non-transitory computer-accessible medium including a computer program thereon which, when executed by a processing arrangement, configures the processing arrangement to perform the procedures comprising:

determining a fracture limit load (Fcts) as a fracture strength parameter of a spot welded portion in at least one of a cross tension using a formula (a) and a fracture limit load (Ftss) as a fracture strength parameter of the spot welded portion in a shear tension using a formula (b), or a shear tension-based on a stress concentration factor α and a fracture strength curve of the spot welded portion obtained from at least one of a tensile strength (TS) of a material strength, a plate thickness t , a nugget diameter d of a spot welding, a plate width w of a joint, and a rotation angle θ of the joint in a tension

testing procedure obtained based on a cross tension testing procedure or a shear tension testing procedure at a spot welded joint, wherein the stress concentration factor α is at least one of (i) defined by a formula of $(TS) / (\text{mean tensile stress } \sigma_0)$ or (ii) calculated using a stress concentration factor calculation formula, and wherein

$$F_{cts} = 2 TS W t \sin \theta / \alpha \quad (a)$$

$$F_{tss} = TS W t / \alpha \quad (b);$$

storing the fracture strength parameter by each steel type in a parameter storage arrangement; and

analyzing a fracture of the spot welded portion by installing the fracture strength parameter stored in the parameter storage arrangement into a fracture limit line in which a deformation at a periphery of the spot welding portion is modeled by a finite element procedure,

wherein the fracture limit line is created as a curve based on a shear force and a vertical force with respect to the spot welded portion.

17. (Previously Presented) The fracture prediction device of claim 9, wherein the shear force is provided in a direction along a member surface of an element that connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

18. (Previously Presented) The fracture prediction device of claim 9, wherein the shear force is determined one after another during a deformation of a collision analysis reproduced using the finite element procedure.

19. (Previously Presented) The fracture prediction device of claim 10, wherein the shear force is provided in a direction along a member surface of an element that connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

20. (Previously Presented) The fracture prediction device of claim 10, wherein the shear force is determined one after another during a deformation of a collision analysis reproduced using the finite element procedure.

21. (Previously Presented) The fracture prediction method of claim 11, wherein the shear force is provided in a direction along a member surface of an element that connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

22. (Previously Presented) The fracture prediction method of claim 11, wherein the shear force is determined one after another during a deformation of a collision analysis reproduced using the finite element procedure.

23. (Previously Presented) The fracture prediction method of claim 12, wherein the shear force is provided in a direction along a member surface of an element that connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

24. (Previously Presented) The fracture prediction method of claim 12, wherein the shear force is determined one after another during a deformation of a collision analysis reproduced using the finite element procedure.

25. (Previously Presented) The computer storage arrangement of claim 13, wherein the shear force is provided in a direction along a member surface of an element that connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

26. (Previously Presented) The computer storage arrangement of claim 13, wherein the shear force is determined by the processing arrangement one after another during a deformation of a collision analysis reproduced using the finite element procedure.

27. (Previously Presented) The computer storage arrangement of claim 14, wherein the shear force is provided in a direction along a member surface of an element that

connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

28. (Previously Presented) The computer storage arrangement of claim 14, wherein the shear force is determined by the processing arrangement one after another during a deformation of a collision analysis reproduced using the finite element procedure.

29. (Previously Presented) The computer-accessible medium of claim 15, wherein the shear force is provided in a direction along a member surface of an element that connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

30. (Previously Presented) The computer-accessible medium of claim 15, wherein the shear force is determined by the processing arrangement one after another during a deformation of a collision analysis reproduced using the finite element procedure.

31. (Previously Presented) The computer-accessible medium of claim 16, wherein the shear force is provided in a direction along a member surface of an element that connects members with each other in which the spot welding is modeled, and the vertical force is provided in a direction that connects members with each other orthogonally to the shear force.

32. (Previously Presented) The computer-accessible medium of claim 16, wherein the shear force is determined by the processing arrangement one after another during a deformation of a collision analysis reproduced using the finite element procedure.

33-36. (Cancelled)

37. (Previously Presented) The fracture prediction device of claim 10, wherein the fracture strength curve provides a graphic representation written by measuring the fracture strength parameter by a test in which at least one of the material strength, the plate thickness, the nugget diameter of the spot welding, the plate width of the joint, or the rotation angle of the particular joint in the tension testing procedure are varied.

38. (Previously Presented) The fracture prediction method of claim 12, wherein the fracture strength curve provides a graphic representation written by measuring the fracture strength parameter by a test in which at least one of the material strength, the plate thickness, the nugget diameter of the spot welding, the plate width of the joint, or the rotation angle of the particular joint in the tension testing procedure are varied.

39. (Previously Presented) The computer storage arrangement of claim 14, wherein the fracture strength curve provides a graphic representation written by measuring the fracture strength parameter by a test in which at least one of the material strength, the

plate thickness, the nugget diameter of the spot welding, the plate width of the joint, or the rotation angle of the particular joint in the tension testing procedure are varied.

40. (Previously Presented) The computer-accessible medium of claim 16, wherein the fracture strength curve provides a graphic representation written by measuring the fracture strength parameter by a test in which at least one of the material strength, the plate thickness, the nugget diameter of the spot welding, the plate width of the joint, or the rotation angle of the particular joint in the tension testing procedure are varied.